

What is claimed is:

1. A display apparatus having a plurality of electron emitters arrayed in association with a plurality of pixels, for emitting electrons from the electron emitters to display an image, characterized in that

necessary charges are accumulated in all the electron emitters in a first period; and

a voltage required to emit electrons is applied to all the electron emitters to cause a plurality of electron emitters which correspond to pixels to emit light therefrom, for emitting light from said pixels, in a second period after said first period.

2. A display apparatus according to claim 1, characterized by:

a drive circuit for scanning all the electron emitters to apply necessary voltages to the electron emitters;

wherein one image is displayed in a period as one frame, said one frame including said first period and said second period;

wherein said drive circuit scans all said electron emitters and applies accumulation voltages depending on the luminance levels of corresponding pixels to the electron emitters which correspond to pixels to emit light therefrom in said first period, and applies a constant emission voltage to all the electron emitters in the second period

after said first period;

wherein charges in amounts depending on the luminance levels of corresponding pixels are accumulated in the electron emitters which correspond to pixels to emit light therefrom in said first period; and

wherein electrons are emitted in amounts depending on the luminance levels of corresponding pixels from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

3. A display apparatus according to claim 2, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal having a constant pulse amplitude; and

an amplitude modulating circuit for amplitude-modulating said pulse signal to generate said accumulation voltage in said first period.

4. A display apparatus according to claim 2, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal applicable to said electron emitters, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable

in level; and

a pulse width modulating circuit for pulse-width-modulating said pulse signal to generate said accumulation voltage in said first period.

5

5. A display apparatus according to claim 1, characterized by:

a drive circuit for scanning all the electron emitters to apply necessary voltages to the electron emitters;

10

wherein one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said first period and said second period;

15

wherein said drive circuit scans all said electron emitters and applies a constant accumulation voltage to the electron emitters to emit light therefrom in said first period, and applies emission voltages depending on luminance levels assigned to the subfields to all said electron emitters in the second period after said first period;

20

wherein a constant amount of charges are accumulated in the electron emitters to emit light therefrom in said first period; and

25

wherein electrons are emitted in amounts depending on the luminance levels assigned to the subfields from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from

the pixels.

6. A display apparatus according to claim 5,  
characterized in that

5       said drive circuit comprises:

      a pulse generating circuit for generating a pulse  
signal having a constant pulse amplitude; and

      an amplitude modulating circuit for amplitude-  
modulating said pulse signal to generate said emission  
10       voltage in said second period.

7. A display apparatus according to claim 5,  
characterized in that

      said drive circuit comprises:

15       a pulse generating circuit for generating a pulse  
signal applicable to said electron emitters, said pulse  
signal having a voltage waveform including a positive-going  
edge or a negative-going edge which is continuously variable  
in level; and

20       a pulse width modulating circuit for pulse-width-  
modulating said pulse signal to generate said emission  
voltage in said second period.

8. A display apparatus according to claim 1,  
25       characterized by:

      a drive circuit for scanning all the electron emitters  
to apply necessary voltages to the electron emitters;

wherein one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said first period and said second period;

wherein said drive circuit scans all said electron emitters and applies accumulation voltages depending on luminance levels assigned to the subfields to the electron emitters to emit light therefrom in said first period, and applies a constant emission voltage to all said electron emitters in the second period after said first period;

wherein charges in amounts depending on the luminance levels assigned to the subfields are accumulated in the electron emitters to emit light therefrom in said first period; and

wherein electrons are emitted in amounts depending on the luminance levels assigned to the subfields from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

9. A display apparatus according to claim 8, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal having a constant pulse amplitude; and

an amplitude modulating circuit for amplitude-

modulating said pulse signal to generate said accumulation voltage in said first period.

10. A display apparatus according to claim 8,  
5 characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse  
signal applicable to said electron emitters, said pulse  
signal having a voltage waveform including a positive-going  
10 edge or a negative-going edge which is continuously variable  
in level; and

a pulse width modulating circuit for pulse-width-  
modulating said pulse signal to generate said accumulation  
voltage in said first period.

15 11. A display apparatus according to claim 1,  
characterized by:

a drive circuit for scanning all the electron emitters  
to apply necessary voltages to the electron emitters;

20 wherein one image is displayed in a period as one  
frame, said one frame being divided into a plurality of  
periods having the same luminance level, each of said  
periods serving as one linear subfield, said one linear  
subfield including said first period and said second period;

25 wherein said drive circuit scans all said electron  
emitters and applies a constant accumulation voltage to the  
electron emitters to emit light therefrom in said liner

subfields in said first period, and applies a constant emission voltage to all said electron emitters in the second period after said first period;

5 wherein a constant amount of charges are accumulated in the electron emitters to emit light therefrom in said linear subfields in said first period; and

10 wherein a constant amount of electrons are emitted from the electron emitters which correspond to pixels to emit light therefrom in the linear subfields in said second period, thereby emitting light from the pixels.

12. A display apparatus according to claim 11, characterized in that

said drive circuit comprises:

15 a pulse generating circuit for generating a pulse signal having a constant pulse amplitude; and

an amplitude modulating circuit for amplitude-modulating said pulse signal to generate said accumulation voltage in said first period.

20 13. A display apparatus according to claim 11, characterized in that

said drive circuit comprises:

25 a pulse generating circuit for generating a pulse signal applicable to said electron emitters, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable

in level; and

a pulse width modulating circuit for pulse-width-modulating said pulse signal to generate said accumulation voltage in said first period.

5

14. A display apparatus according to claim 1, characterized by:

a drive circuit for scanning all the electron emitters to apply necessary voltages to the electron emitters;

10

wherein one image is displayed in a period as one frame, said one frame including said first period and said second period;

15

wherein said drive circuit applies a constant accumulation voltage to all said electron emitters in said first period, and scans all said electron emitters and applies emission voltages depending on the luminance levels of corresponding pixels to the electron emitters which correspond to pixels to emit light therefrom in said second period after said first period;

20

wherein a constant amount of charges are accumulated in all said electron emitters in said first period; and

25

wherein electrons are emitted in amounts depending on the luminance levels of corresponding pixels from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.



15. A display apparatus according to claim 14,  
characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse  
5 signal having a constant pulse amplitude; and

an amplitude modulating circuit for amplitude-  
modulating said pulse signal to generate said emission  
voltage in said second period.

10 16. A display apparatus according to claim 14,  
characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse  
signal applicable to said electron emitters, said pulse  
15 signal having a voltage waveform including a positive-going  
edge or a negative-going edge which is continuously variable  
in level; and

a pulse width modulating circuit for pulse-width-  
modulating said pulse signal to generate said emission  
20 voltage in said second period.

17. A display apparatus according to claim 1,  
characterized by:

a drive circuit for scanning all the electron emitters  
25 to apply necessary voltages to the electron emitters;

wherein one image is displayed in a period as one  
frame, said one frame being divided into a plurality of

periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said first period and said second period;

wherein said drive circuit applies accumulation  
5 voltages depending on luminance levels assigned to the subfields to all said electron emitters to emit light therefrom in said first period, and scans all said electron emitters and applies a constant emission voltage to said electron emitters to emit light therefrom in the second  
10 period after said first period;

wherein charges in amounts depending on the luminance levels assigned to the subfields are accumulated in all said electron emitters in said first period; and

wherein electrons are emitted in amounts depending on  
15 the luminance levels assigned to the subfields from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

20 18. A display apparatus according to claim 17, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse  
signal having a constant pulse amplitude; and

25 an amplitude modulating circuit for amplitude-modulating said pulse signal to generate said accumulation voltage in said first period.

19. A display apparatus according to claim 17,  
characterized in that

said drive circuit comprises:

5 a pulse generating circuit for generating a pulse  
signal applicable to said electron emitters, said pulse  
signal having a voltage waveform including a positive-going  
edge or a negative-going edge which is continuously variable  
in level; and

10 a pulse width modulating circuit for pulse-width-  
modulating said pulse signal to generate said accumulation  
voltage in said first period.

20. A display apparatus according to claim 1,  
characterized by:

15 a drive circuit for scanning all the electron emitters  
to apply necessary voltages to the electron emitters;

20 wherein one image is displayed in a period as one  
frame, said one frame being divided into a plurality of  
periods having respective different luminance levels, each  
of said periods serving as one subfield, said one subfield  
including said first period and said second period;

25 wherein said drive circuit applies a constant  
accumulation voltage to all said electron emitters in said  
first period, and scans all said electron emitters and  
applies emission voltages depending on the luminance levels  
assigned to the subfields to the electron emitters to emit  
light therefrom in said second period after said first

period;

wherein a constant amount of charges are accumulated in all said electron emitters in said first period; and

wherein electrons are emitted in amounts depending on the luminance levels assigned to the subfields from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

21. A display apparatus according to claim 20, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal having a constant pulse amplitude; and

an amplitude modulating circuit for amplitude-modulating said pulse signal to generate said emission voltage in said second period.

22. A display apparatus according to claim 20, characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal applicable to said electron emitters, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable in level; and

a pulse width modulating circuit for pulse-width-

modulating said pulse signal to generate said emission voltage in said second period.

23. A display apparatus according to claim 1,  
5 characterized by:

a drive circuit for scanning all the electron emitters to apply necessary voltages to the electron emitters;

wherein one image is displayed in a period as one frame, said one frame being divided into a plurality of  
10 periods having the same luminance level, each of said periods serving as one linear subfield, said one linear subfield including said first period and said second period;

wherein said drive circuit applies a constant accumulation voltage to all said electron emitters in said  
15 first period, and scans all said electron emitters and applies a constant emission voltage to the electron emitters to emit light therefrom in the linear subfields in said second period after said first period;

wherein a constant amount of charges are accumulated in  
20 the electron emitters to emit light therefrom in the linear subfields in said first period; and

wherein a constant amount of electrons are emitted from the electron emitters which correspond to pixels to emit light therefrom in the linear subfields in said second  
25 period, thereby emitting light from the pixels.

24. A display apparatus according to claim 23,

characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal having a constant pulse amplitude; and

5 an amplitude modulating circuit for amplitude-modulating said pulse signal to generate said emission voltage in said second period.

25. A display apparatus according to claim 23,  
10 characterized in that

said drive circuit comprises:

a pulse generating circuit for generating a pulse signal applicable to said electron emitters, said pulse signal having a voltage waveform including a positive-going  
15 edge or a negative-going edge which is continuously variable in level; and

a pulse width modulating circuit for pulse-width-modulating said pulse signal to generate said emission voltage in said second period.

20  
26. A display apparatus according to claim 1, wherein said electron emitters have such characteristics that the electron emitters change to a state (first state) in which electrons are accumulated when an electric field is applied  
25 in one direction to said electron emitters, and change from said first state to a state (second state) in which electrons are emitted when an electric field is applied in

another direction to said electron emitters, and said drive circuit is controlled to apply a voltage between a voltage for changing the electron emitters to said first state and a voltage for changing the electron emitters to a state immediately prior to said second state, to electron emitters which are unselected.

27. A method of driving a display apparatus having a plurality of electron emitters arrayed in association with a plurality of pixels, for emitting electrons from the electron emitters to display an image, characterized by:

the step of accumulating necessary charges in all the electron emitters in a first period; and

the step of applying a voltage required to emit electrons to all the electron emitters to cause a plurality of electron emitters which correspond to pixels to emit light therefrom, for emitting light from said pixels, in a second period after said first period.

28. A method for driving a display apparatus according to claim 27, characterized in that

one image is displayed in a period as one frame, said one frame including said first period and said second period; and characterized by

the step of scanning all said electron emitters, and applying accumulation voltages depending on the luminance levels of corresponding pixels to the electron emitters

which correspond to pixels to emit light therefrom in said first period, to accumulate charges in amounts depending on the luminance levels of corresponding pixels in the electron emitters which correspond to pixels to emit light therefrom in said first period; and

the step of applying a constant emission voltage to all the electron emitters in the second period after said first period, to emit electrons in amounts depending on the luminance levels of corresponding pixels from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

29. A method for driving a display apparatus according to claim 28, characterized in that

a pulse signal having a constant pulse amplitude is generated; and

said pulse signal is amplitude-modulated to generate said accumulation voltage in said first period.

30. A method for driving a display apparatus according to claim 28, characterized in that

a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable in level; and

said pulse signal is amplitude-modulated to generate



said accumulation voltage in said first period.

31. A method for driving a display apparatus according to claim 27, characterized in that

5           one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said first period and said second period; and characterized by

10           the step of scanning all said electron emitters, applying a constant accumulation voltage to the electron emitters to emit light therefrom in said first period, to accumulate a constant amount of charges in the electron emitters to emit light therefrom in said first period; and

15           the step of applying emission voltages depending on luminance levels assigned to the subfields to all said electron emitters in the second period after said first period, to emit electrons in amounts depending on the luminance levels assigned to the subfields from the electron  
20           emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

32. A method for driving a display apparatus according to claim 31, characterized in that

25           a pulse signal having a constant pulse amplitude is generated; and

said pulse signal is amplitude-modulated to generate  
said emission voltage in said second period.

33. A method for driving a display apparatus according  
to claim 31, characterized in that

a pulse signal applicable to said electron emitters is  
generated, said pulse signal having a voltage waveform  
including a positive-going edge or a negative-going edge  
which is continuously variable in level; and

said pulse signal is pulse-width-modulated to generate  
said emission voltage in said second period.

34. A method for driving a display apparatus according  
to claim 27, characterized in that

one image is displayed in a period as one frame, said  
one frame being divided into a plurality of periods having  
respective different luminance levels, each of said periods  
serving as one subfield, said one subfield including said  
first period and said second period; and characterized by

the step of scanning all said electron emitters, and  
applying accumulation voltages depending on luminance levels  
assigned to the subfields to the electron emitters to emit  
light therefrom in said first period, to accumulate charges  
in amounts depending on the luminance levels assigned to the  
subfields in the electron emitters to emit light therefrom  
in said first period; and

the step of applying a constant emission voltage to all

said electron emitters in the second period after said first period, to emit electrons in amounts depending on the luminance levels assigned to the subfields from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

35. A method for driving a display apparatus according to claim 34, characterized in that

a pulse signal having a constant pulse amplitude is generated; and

said pulse signal is amplitude-modulated to generate said accumulation voltage in said first period.

36. A method for driving a display apparatus according to claim 34, characterized in that

a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable in level; and

said pulse signal is pulse-width-modulated to generate said accumulation voltage in said first period.

37. A method for driving a display apparatus according to claim 27, characterized in that

one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having

the same luminance level, each of said periods serving as one linear subfield, said one linear subfield including said first period and said second period; and characterized by

the step of scanning all said electron emitters, and  
5 applying a constant accumulation voltage to the electron emitters to emit light therefrom in said linear subfields in said first period, to accumulate a constant amount of charges in the electron emitters to emit light therefrom in said linear subfields in said first period; and

10 the step of applying a constant emission voltage to all said electron emitters in the second period after said first period, to emit a constant amount of electrons from the electron emitters which correspond to pixels to emit light therefrom in the linear subfields in said second period,  
15 thereby emitting light from the pixels.

38. A method for driving a display apparatus according to claim 37, characterized in that

a pulse signal having a constant pulse amplitude is  
20 generated; and

said pulse signal is amplitude-modulated to generate said accumulation voltage in said first period.

39. A method for driving a display apparatus according to claim 37, characterized in that

25 a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform

including a positive-going edge or a negative-going edge which is continuously variable in level; and

said pulse signal is pulse-width-modulated to generate said accumulation voltage in said first period.

5

40. A method for driving a display apparatus according to claim 27, characterized in that

one image is displayed in a period as one frame, said one frame including said first period and said second period; and characterized by

10

the step of applying a constant accumulation voltage to all said electron emitters in said first period to accumulate a constant amount of charges in all said electron emitters in said first period; and

15

the step of scanning all said electron emitters and applying emission voltages depending on the luminance levels of corresponding pixels to the electron emitters which correspond to pixels to emit light therefrom in said second period after said first period, to emit electrons in amounts depending on the luminance levels of corresponding pixels from the electron emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

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41. A method for driving a display apparatus according to claim 40, characterized in that

a pulse signal having a constant pulse amplitude is

generated; and

said pulse signal is amplitude-modulated to generate said accumulation voltage in said second period.

5           42. A method for driving a display apparatus according to claim 40, characterized in that

a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge  
10 which is continuously variable in level; and

said pulse signal is pulse-width-modulated to generate said accumulation voltage in said second period.

15           43. A method for driving a display apparatus according to claim 27, characterized in that

one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said  
20 first period and said second period; and characterized by

the step of applying accumulation voltages depending on luminance levels assigned to the subfields to all said electron emitters to emit light therefrom in said first period, to accumulate charges in amounts depending on the  
25 luminance levels assigned to the subfields in all said electron emitters in said first period; and

the step of scanning all said electron emitters and

applying a constant emission voltage to said electron  
emitters to emit light therefrom in the second period after  
said first period, to emit electrons in amounts depending on  
the luminance levels assigned to the subfields from the  
5 electron emitters which correspond to pixels to emit light  
therefrom in said second period, thereby emitting light from  
the pixels.

44. A method for driving a display apparatus according  
10 to claim 43, characterized in that

a pulse signal having a constant pulse amplitude is  
generated; and

said pulse signal is amplitude-modulated to generate  
said accumulation voltage in said first period.

45. A method for driving a display apparatus according  
15 to claim 43, characterized in that

a pulse signal applicable to said electron emitters is  
generated, said pulse signal having a voltage waveform  
20 including a positive-going edge or a negative-going edge  
which is continuously variable in level; and

said pulse signal is pulse-width-modulated to generate  
said accumulation voltage in said first period.

46. A method for driving a display apparatus according  
25 to claim 27, characterized in that

one image is displayed in a period as one frame, said

one frame being divided into a plurality of periods having respective different luminance levels, each of said periods serving as one subfield, said one subfield including said first period and said second period; and characterized by

5           the step of applying a constant accumulation voltage to all said electron emitters in said first period, to accumulate a constant amount of charges in all said electron emitters in said first period; and

10           the step of scanning all said electron emitters and applying emission voltages depending on the luminance levels assigned to the subfields to the electron emitters to emit light therefrom in said second period after said first period, to emit electrons in amounts depending on the luminance levels assigned to the subfields from the electron  
15           emitters which correspond to pixels to emit light therefrom in said second period, thereby emitting light from the pixels.

20           47. A method for driving a display apparatus according to claim 46, characterized in that

          a pulse signal having a constant pulse amplitude is generated; and

          said pulse signal is amplitude-modulated to generate said emission voltage in said second period.

25           48. A method for driving a display apparatus according to claim 46, characterized in that



a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable in level; and

5           said pulse signal is pulse-width-modulated to generate said emission voltage in said second period.

49. A method for driving a display apparatus according to claim 27, characterized in that

10           one image is displayed in a period as one frame, said one frame being divided into a plurality of periods having the same luminance level, each of said periods serving as one linear subfield, said one linear subfield including said first period and said second period; and characterized by

15           applying a constant accumulation voltage to all said electron emitters in said first period, to accumulate a constant amount of charges in the electron emitters to emit light therefrom in the linear subfields in said first period; and

20           the step of scanning all said electron emitters and applying a constant emission voltage to the electron emitters to emit light therefrom in the linear subfields in said second period after said first period, to emit a constant amount of electrons from the electron emitters  
25           which correspond to pixels to emit light therefrom in the linear subfields in said second period, thereby emitting light from the pixels.

50. A method for driving a display apparatus according to claim 49, characterized in that

a pulse signal having a constant pulse amplitude is generated; and

5        said pulse signal is amplitude-modulated to generate said emission voltage in said second period.

51. A method for driving a display apparatus according to claim 49, characterized in that

10        a pulse signal applicable to said electron emitters is generated, said pulse signal having a voltage waveform including a positive-going edge or a negative-going edge which is continuously variable in level; and

15        said pulse signal is pulse-width-modulated to generate said emission voltage in said second period.

52. A method for driving a display apparatus according to claim 27, characterized in that

20        said electron emitters have such characteristics that the electron emitters change to a state (first state) in which electrons are accumulated when an electric field is applied in one direction to said electron emitters, and change from said first state to a state (second state) in which electrons are emitted when an electric field is  
25        applied in another direction to said electron emitters; and

a voltage between a voltage for changing the electron emitters to said first state and a voltage for changing the

electron emitters to a state immediately prior to said second state, is applied to electron emitters which are unselected.